REMARKS

In view of the above amendments and following remarks, r consideration and further examination are requested.

The specification and abstract have been reviewed and revised to make editorial changes thereto and generally improve the form thereof, and a substitute specification and abstract are provided. No new matter has been added by the substitute specification and abstract. Also, enclosed is a "marked-up" copy of the original specification and abstract to show changes that have been incorporated into the substitute specification and abstract. The attached pages are captioned ***"Version With Markings To Show Changes Made."***

In response to the objections to the drawings as expressed in section 1 on page 2 of the Office Action, the following is provided. Lands as recited in former claim 2 and new claim 23 are represented as numeral 70 in Figure 12. The land as recited in former claim 3 and new claim 24 is represented by numeral 73 in Figure 13. The internal layer as recited in former claim 3 and new claim 24 is represented by numeral 72 in Figure 13. With regard to the subject matter of former claim 6 and new claim 27, please note that this subject matter is shown in Figure 10. Also, please note that the claims no longer recite "first recess". In view of the above it is respectfully submitted that the objections to the drawings have been addressed and that the drawings are free of the objections noted by the Examiner.

In response to the 35 U.S.C. 112, first paragraph, rejection and 35 U.S.C. 112, second paragraph, rejection as recited in sections 3 and 4 on pages 2-4 of the Office Action, claims 1-20 have been replaced by new claims 21-43. These new claims have been drafted taking into account the 35 U.S.C. 112 rejections issued by the Examiner, are believed to be free of the 35 U.S.C. 112 concerns expressed by the Examiner, and ar otherwise believed to be in compliance with 35 U.S.C. 112, first and second paragraphs.

In this regard, in response to the Examiner's 35 U.S.C. 112 concerns xpressed with regard to claim 2, please note that the claims now recite "a land...adjacent said recess". In response to the Examiner's 35 U.S.C. 112 concerns expressed with regard to claim 3, please note that the claims now recite "a land adjacent said electrode". In response to the Examiner's 35 U.S.C. 112 concerns expressed with regard to claim 6, please note that the claims now recite "said recess is formed from plural recesses". In response to the Examiner's 35 U.S.C. 112 concerns expressed with regard to claim 10, please note that the claims now recite "said lateral side of said metal shield case being more textured than said upper side of said metal shield case". In response to the Examiner's 35 U.S.C. 112 concerns expressed with regard to claim 15 and 20, these claims have been rewritten as new claims 38 and 43. Also, it is respectfully submitted that from the claims and specification it is sufficiently clear as to what is intended by the claimed lands and recesses.

Accordingly, the claims are believed to be fully supported by the specification, and the claims are believed to be sufficiently clear such that one having ordinary skill in the art would fully appreciate and understand Applicant's invention.

The instant invention pertains to a module and a method for producing the module. A prior art module includes a substrate having a lateral side, a recess in the lateral side, and an electrode the recess. The substrate is produced by forming holes through a mother board, plating an interior surface of the holes with a metal, and then cutting the mother board through the holes and the metal plating so as to produce substrates each having an electrode in a recess in a lateral side thereof.

This known module and method of its manufacture suffer from a drawback in that because the mother board is cut through the metal plating on the interior surface of the holes, burrs are likely to be developed. These burrs reduce quality of the module in that when the module is mounted in a circuit assembly, the burrs may become detached by vibrations and result in a short-circuit. Accordingly, these burrs are required to be removed

by a worker after cutting of the mother board into individuals substrates. This removal step reduces production efficiency.

Applicant has addressed and resolved this drawback by developing a unique module and method for its manufacture, which method does not result in any burrs being formed upon cutting of a mother board into individual substrates. Specifically, prior to cutting the mother board into individual substrates, removed is a portion of metal plating on an interior surface of a hole through which cutting is to be performed. Then cutting is performed through portions of the interior surface of the hole from which the metal plating has been removed. Accordingly, because the mother board is cut through portions of the interior surface of the hole from which the metal plating has been removed, no burrs are developed such that the additional removal step of the prior art is not required.

Claim 21 is believed to be representative of the inventive module, and claims 34 and 39 are believed to be representative of the inventive method of manufacturing the module.

The Examiner rejected claims 1-6 under 35 U.S.C. 102(e) as being anticipated by Gotoh et al. The Examiner rejected claims 11-13 and 16-18 under 35 U.S.C. 102(e) as being anticipated by Wajima. The Examiner rejected claims 7-10 under 35 U.S.C. 103(a) as being unpatentable over Gotoh et al. And, the Examiner rejected claims 14, 15, 19 and 20 under 35 U.S.C. 103(a) as being unpatentable over Wajima. These rejections are respectfully traversed and Gotoh et al. and Wajima are not applicable with regard to th newly added claims for the following reasons.

Claim 21 recites a module that comprises

> a substrate having a lateral side...a recess in said lateral side...and an electrode in said recess and **spaced** from said lateral side (emphasis added)

Such a module is not taught or suggested by Gotoh et al.

In this regard, in rejecting claim 1 as being anticipated by Gotoh et al., the Examiner took the position that Gotoh et al. discloses a substrate 1 having a recess formed in a lateral side thereof, and an electrode 42 in this recess. However, as shown in Figure 5 of Gotoh et al., the electrode 42 extends up to the lateral side of the substrate 1 and thus is not "spaced from said lateral side" as recited in claim 21. Accordingly, claim 21 is not anticipated by Gotoh et al. Accordingly, claims 21-33 are allowable over Gotoh et al.

Also, certain of the dependent claims are believed to be patentable over Gotoh et al. in their own right. In this regard, claim 28 recites that the module further comprises a metal shield case having "a leg joined to said to electrode". While the Examiner has taken Official Notice that it is known to have a module including a metal shield case having a leg, claim 28 requires that more than this. Specifically, claim 28 recites that the leg is **joined** to the electrode. Thus, claim 28 is patentable in its own right.

Additionally, claim 31 requires that the metal shield case has a lateral side which is "more textured" than an upper side of the metal shield case. This feature is not taught or suggested by Gotoh et al., such that claim 31 is patentable in its own right.

And, claim 33 requires that no portion of the electrode is co-planar with a surface of the lateral side of the substrate. In Gotoh et al., because electrode 42 extends up to the lateral side of the substrate 1, a portion of the electrode is co-planar with a surface of the lateral side of the substrate. Thus, claim 33 is also patentable in its own right.

With regard to method claims 34 and 39, each of these claims recite

> removing the exposed part of said metal plated
> portion from said interior surface of said hole.

Such removal is not taught or suggested by Wajima. In this regard, while Wajima does disclose providing a metal plating 16a or 16b on an interior surface of hole 12, no portion of this metal plating is removed from the interior surface of the hole 12. Thus, claims 34 and 39 are not anticipated by Wajima. Accordingly, claims 34-43 are allowable over Wajima.

Additionally, dependent claims 35 and 40 are each believed to be patentable in its own right, since these claims ach recite

> cutting said mother board through portions of said interior surface of said hole from which said exposed part of said metal plated portion was removed.

Such cutting is neither taught nor suggested by Wajima.

In this regard, because Wajima does not teach or suggest removal of any metal plating from interior of the holes 12 as expressed above, when the mother board of Wajima is cut through the holes to provide individual substrates, the cutting cannot occur through portions of the interior surface of the hole 12 from which metal plating was removed. Thus, claims 35 and 40 are each patentable in its own right.

In view of the above amendments and remarks, it is respectfully submitted that th present application is in condition for allowance and an early Notice of Allowance is earnestly solicited.

If after reviewing this Amendment, the Examiner believes that any issues remain which must be resolved before the application can be passed to issue, the Examiner is invited to contact the Applicant's undersigned representative by telephone to resolve such issues.

Respectfully submitted,

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Version with Markings to Show Changes Made

MODULE AND METHOD OF MANUFACTURING THE MODULE

~~Module and Method of Manufacturing the Module~~

FIELD OF THE INVENTION

~~Field of the Invention~~

The present invention relates to a module such as a high-frequency module for a small sized electronic apparatus such as a mobile telephone, a method of manufacturing the module, and particularly to a signal electrode provided on a printed circuit board for the high-frequency module.

BACKGROUND OF THE INVENTION

~~Background of the Invention~~

A conventional high-frequency module includes a substrate of substantially a four-sided shape having a recess provided in ~~the~~ each cut side thereof, an electronic component mounted on the substrate, and a signal electrode provided at the recesses. One end of the signal electrode is exposed at the cut~~ting~~ sides.

The substrate is manufactured ~~by~~ in the following manner. As shown in Fig. 18, a printed mother board 2 incorporates an array of substrates 1 for high-frequency modules. As shown in Fig. 19, each of the substrates 1 has a pattern of a signal electrode 3 provided at all ~~the~~ lateral sides thereof where neighboring substrates 1 are linked. Also, a signal electrode 4 is provided at each corner of ~~the~~ each substrate 1. The signal electrodes 3 and 4 are formed ~~through~~ by forming holes and coating the holes with copper plating so as to allow the holes to function~~ing~~ as through holes. The printed mother board 2 is then cut along a joint 5 to provide the substrates 1.

~~Since~~ Because of having ~~a~~ copper plated signal electrodes 3 and 4 cut along the joint 5, each conventional high-frequency module may have burrs developed at its edges. The burrs decline quality of the plating of each signal electrode. More specifically, when the module is mounted in a circuit assembly, the

burrs possibly ~~is~~ are detached by adverse vibrations, thus causing a short-circuit. Hence, the burrs need to be removed ~~in~~ during an extra process step performed by a worker.

SUMMARY OF THE INVENTION
~~Summary of the Invention~~

A module includes a substantially four-sided substrate having a recess formed at a lateral side thereof, an electrode ~~which is~~ provided at the recess of the substrate, ~~and has~~ an absent portion between ~~the~~ lateral sides of the substrate, and an electronic component mounted on the substrate. The module has the electrode without unwanted burrs.

BRIEF DESCRIPTION OF THE DRAWINGS
~~Brief Description of the Drawings~~

Fig. 1 is a flowchart for manufacturing a printed mother board according to Embodiment 1 of the present invention.

Fig. 2 is an enlarged plan view of a primary part of the printed mother board according to Embodiment 1.

Fig. 3 is a plan view of the printed mother board according to Embodiment 1.

Fig. 4 is an enlarged plan view of a first primary part of the printed mother board according to Embodiment 1.

Fig. 5 is an enlarged plan view of a second primary part of the printed mother board according to Embodiment 1.

Fig. 6 is an enlarged cross sectional view of the primary part of the printed mother board according to Embodiment 1.

Fig. 7 is a flowchart for manufacturing a high-frequency module according to Embodiment 1.

Fig. 8 is a flowchart for manufacturing a printed mother board according to Embodiment 2 of the present invention.

Fig. 9 is an enlarged plan view of a primary part of the printed mother board according to Embodiment 2.

Fig. 10 is a plan view of a region adjoining a hole of a printed mother board according to Embodiment 3 of the present invention.

Fig. 11 is a perspective view of a high-frequency module according to Embodiment 4 of the present invention.

Fig. 12 is a perspective view of a primary part of the high-frequency module of Embodiment 4.

Fig. 13 is a perspective view of a primary part of an internal layer substrate of Embodiment 4.

Fig. 14 is a perspective view showing the high-frequency module and its neighboring area according to Embodiment 4.

Fig. 15 is a plan view of a ~~the~~ back side of the high-frequency module of Embodiment 4.

Fig. 16 is a cross sectional view of a primary part of a shield case die according to Embodiment 4.

Fig. 17 is a cross sectional view of a primary part of the high-frequency module of Embodiment 4.

Fig. 18 is a plan view of a conventional printed mother board.

Fig. 19 is an enlarged plan view of a primary part of the conventional printed mother board.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

~~Description of the Preferred Embodiments~~

(Embodiment 1)

Fig. 1 is a flowchart for manufacturing a printed mother board according to Embodiment 1 of the present invention. Fig, 2 is a plan view of a primary part of the printed mother board. Fig. 3 is a plan view of the

printed mother board. Fig. 4 is a plan view of a first primary part of the printed mother board. Fig. 5 is a plan view of a second primary part of the printed mother board. Fig. 6 is a cross sectional view of the first primary part of the printed mother board. Fig. 7 is a flowchart for manufacturing a high-frequency module according to Embodiment 1.

Embodiment 1 of the present invention will be described referring to ~~the~~ relevant drawings. A substrate used as a ~~the~~ high-frequency module will be described ~~at~~ first.

As shown in Fig. 3, a ~~the~~ printed mother board 11 incorporates an array of ~~the~~ substrates 12 where any two adjacent substrates are linked to each other along vertical and horizontal joints 13. Fig. 4 illustrates a ~~the~~ substrate 12 having ~~has~~ a signal electrode 15 provided on a link side 14 at which ~~the~~ substrates adjoin. ~~It is now noted that~~ A copper-plating-absent region 17 is wider than a cutting strip 16 along which a ~~the~~ joint 13 is separated. This allows the signal electrode 15 to generate no burrs during ~~the~~ separation along the cutting strip 16.

Fig. 5 is an enlarged view of a corner joint 18 where four of the substrates 12 meet. A signal electrode 19 of each substrate 12 is provided at the corner joint 18 as shown in Fig. 5. Similar to Fig. 4, a copper-plating absent region 21 is ~~arranged~~ wider than a cutting strip 20. This allows a ~~the~~ corresponding signal electrode 19 to generate no burrs during ~~the~~ separation along the cutting strip 20. Also, since four ~~of the~~ signal electrodes 19 are simultaneously provided when one single hole is drilled through the corner joint 18, a ~~the~~ number of manufacturing steps ~~processes~~ can be reduced thus and ~~the~~ life of a drill used for drilling can be increased.

Fig. 6 is a cross sectional view of the signal electrode 15 manufactured by the above manner. Since the copper-plating-absent region 17 is wider

than the cutting strip 16, burrs are hardly produced during ~~the~~ separation along the cutting strip 16.

A ~~The~~ procedure of manufacturing the signal electrodes 15 and 19 will be described in more detail referring to the flowchart of Fig. 1. The flowchart of Fig. 1 illustrates a ~~the~~ procedure of manufacturing a printed ~~printing~~ mother board with a positive photo-resist. A through hole is drilled at a region for a signal electrode on a ~~the~~ joint 13 of two ~~of the~~ adjoining substrates 12 of a ~~the~~ printed mother board 11 (Step 25). Then, copper plating is performed at a ~~the~~ region for a ~~the~~ signal electrode about the hole (Step 26). This ~~The~~ region is then coated with the resist (Step 27). The resist is then cured (Step 28). While ~~Being~~ covered with a mask 33 as shown in Fig. 2,the mother board is exposed to light (Step 29). The mask 33 has a recess 33a positioned over the signal electrode formed at a border of the two of the adjoining substrates 12. The adjoining substrates 12 are linked to each other along the joint 13. Only a portion corresponding to the recess 33a of the resist is exposed to ~~the~~ light and thus decomposed. Then, ~~the~~ decomposed portions of the resist are removed (Step 30). ~~The~~ Copper plating at a ~~the~~ portion where the resist is removed is removed (Step 31). The printed mother board 11 is then stored (Step 32).

Then, solder paste ~~soldering~~ is applied on the printed mother board 11 (Step 102) as shown in Fig. 7. Then an electronic component is mounted onto the printed mother board 11 (Step 103) and soldered to the substrates 12 with a reflow furnace (Step 104). On the board 11, a slit ~~along~~ is formed along ~~the~~ lateral sides of each substrate 12 by dicing (Step 105). The signal electrodes 15 and 19 of each substrate 12 are electrically separated from those of the adjoining substrates 12. Water for ~~the~~ dicing is discharged (Step 106). Each ~~The~~ substrate 12 is then provided with power from pins of an ~~a~~ inspecting device for examining ~~the~~ oscillation frequency (a first inspection) and is subjected to laser

trimming to oscillate at a desired frequency (Step 107). ~~The~~ Each substrate 12 is then rinsed (Step 108) and covered with a shield case (Step 109). A mark is impressed on the shield case (Step 110). A pattern of the paste solder is transferred onto ~~the~~ each substrate 12 (Step 111) and subjected to a reflow process to fix the shield case onto the substrate 12 (Step 112). ~~The~~ Each substrate 12 is finally examined (a second inspection) with regard to ~~in~~ electrical properties (Step 112). The substrates 12 are then separated from the printed mother board 11 (Step 114). The substrates 12, high-frequency modules, are loaded on to a tape (Step 115) and stored (Step 116). Since the steps up to the final inspection at step 113 are carried out with the substrates 12 in the form of a worksheet, i.e. the printed mother board 11 which is not separated, ~~the~~ a high-frequency module can be manufactured significantly efficiently.

Referring to Fig. 2, ~~the~~ two recesses 33a of the mask 33 are separated from each other by 180 degrees for determining ~~the~~ a signal electrode 15 of ~~the~~ a substrate 12. For determining ~~the~~ signal electrodes 19 at ~~the~~ a corner joint 18, ~~the~~ mask 33 would include~~s~~ ~~the~~ four recesses 33a provided therein at an equal interval~~s~~ of 90 degrees. In this case, the mask 33 is placed with its recesses 33a ~~positioning~~ positioned above the corner joint ~~13~~ 18 where ~~the~~ four substrates 12 meet. ~~The~~ A width of the recesses 33a determines ~~the~~ a width of ~~the~~ copper plating absent regions 17 and 21.

Since ~~including~~ the copper plating absent regions 17 and 21 (See Figs. 4 and 5) are determined with the mask 33, the mother board ~~12~~ 11 has no burrs produced during ~~the~~ separation along the cutting strips ~~13~~ board 20. That is, ~~the~~ separated regions of each substrate 12 has a better quality, even by a visual inspection, than ~~the~~ a conventional substrate having ~~the~~ signal electrode regions which are cut directly.

(Embodiment 2)

A printed mother board 11 according to Embodiment 2 is identical to that of Embodiment 1 shown in Fig. 3 through Fig. 6, but different ~~from it in~~ therefrom with regard to a manufacturing method.

Fig. 8 is a flowchart for manufacturing a printed mother board 11 with a negative photo-resist according to Embodiment 2 of the present invention. A through-hole is drilled at a region for a signal electrode at a joint 13 between two adjacent substrates 12 of the printed mother board 11 (Step 35). ~~The~~ A region about the through-hole is copper-plated (Step 36), coated with ~~the~~ a resist (Step 37), and exposed to light through a mask 34 as shown in Fig. 9 (Step 38). The mask 34 has ~~the~~ projections 34a positioned over ~~the~~ a region for ~~the~~ a signal electrode of the two adjacent substrates 12. The adjacent substrates 12 are linked to each other along the joint 13. ~~Thereby,~~ The resist is removed, except that portions not corresponding to the projections 34a of the mask 33 ~~is~~ are exposed to ~~the~~ light and thus cured. ~~The~~ Uncured portions of the resist protected with the projections 34a are removed by etching (Step 39). ~~The~~ A copper-plated portion covered with no resist (corresponding to the projections 34a) is also removed by etching (Step 40). The printed mother board 11 is stored (Step 41). A method of manufacturing a high-frequency module is identical to that of Embodiment 1 as described with reference to Fig. 7.

As shown in Fig. 9, the projections 34a of the mask 34 for manufacturing the printed mother board 11 are separated from each other by 180 degrees for determining ~~the~~ signal electrodes 15 of ~~the~~ substrates 12. For determining ~~the~~ signal electrodes 19 at ~~the~~ a corner joint 18, the mask 34 would ~~has~~ have four ~~of the~~ projections 34a provided at ~~an~~ equal intervals of 90 degrees. In this case, the mask 34 has the projections 34a positioned along the joint 13 between the substrates 12. ~~The~~ A width of the projection 34a determines

~~the~~ a width of ~~the~~ copper-plating-absent regions 17 and 21 of the signal electrodes 15 and 19. Since the copper-plating-absent regions 17 and 21 (Fig. 4 and Fig. 5) are determined by ~~the~~ a shape of the mask 34, burrs ~~is~~ are hardly produced during ~~the~~ separation along the joint 13. Edges at ~~the~~ a signal electrode have significantly improved quality as compared with ~~the~~ a conventional substrate, even by ~~a~~ visual inspection.

(Embodiment 3)

Fig. 10 is an enlarged plan view of a primary part for explaining a method of manufacturing a signal electrode 52 provided along a joint 51 between two substrates 50. Along the signal electrode 52, a row of round holes 53 to 57 each having a radius R is formed at an equal distance R. The radius R of the round holes is 0.5 mm in this embodiment. The round holes may be formed by drilling. It is also noted that the round holes are drilled alternately. For example, ~~the~~ round hole 53 is drilled, and then ~~the~~ round hole 55 and ~~the~~ round hole 57 ~~are~~ drilled. Then, ~~the~~ round hole 54 and ~~the~~ round hole 56 are drilled. Thereby, centers for ~~the~~ drilling ~~remains~~ are not diverted, whereby ~~hence being locating~~ the round holes are located accurately.

A shield case has a leg 58 placed over one of the substrates 50, and forms ~~forming~~ a space 59 between the signal electrode 52 and the leg. The space 59 between the signal electrode 52 and the leg 58 is filled up with a solder paste ~~by a~~ via capillary action, thus improving ~~enabling~~ secure soldering of the case ~~to be soldered securely~~.

(Embodiment 4)

A high-frequency module manufactured by the method of Embodiments 1 to 3 will be described. The module includes a substrate 62 identical to a substrate 12 described in Embodiments 1 to 3.

Fig. 11 is an external perspective view of ~~the~~ a high-frequency module 60. The high-frequency module 60 includes the substrate 62 having substantially a four-sided shape, a recess 64 provided in a cut side 63 of the substrate 62, a signal electrode 65~~x~~ provided in the recess 64, an electronic component mounted on the substrate 62, and a shield case 66 for shielding the electronic component. The signal electrode 65~~x~~ has an end 67 separated from the cut side 63 by ~~an absent distance~~ a thickness 68 of an insulator (air in the present embodiment), such that no portion of the signal electrode is co-planar with the cut side.

Since the ~~absent distance~~ thickness 68 of the air provided between the end 67 and the cut side 63 allows the signal electrode 65~~x~~ to be intact during ~~the~~ separation of the substrate 62 from a mother board, ~~thus producing~~ no burrs are produced. The signal electrode 65~~x~~, ~~since~~ because of being provided in the recess 64, is hardly polluted during handling. Also, ~~the~~ an overall mounting area of the module can be reduced.

The signal electrode 65 is classified into a large size signal electrode 65a and a small size signal electrode 65b. The large size signal electrode 65a may be used for grounding, and the small size signal electrode 65b may function as an ordinary signal electrode~~x~~. If being not classified, the signal electrodes may be sized identically.

Fig. 12 is a perspective view of a region ~~65~~ 69 for the signal electrode. The region ~~65~~ 69 consists of a land 70 mounted on upper and lower sides of the substrate 62. Upon having the signal electrodes connected at ~~the~~ a lower side of the substrate, the module can reduce ~~the~~ an overall size of a device including the module mounted thereto.

Fig. 13 illustrates a substrate 62 of this embodiment having a multi-layer construction. As shown, the substrate 62 includes an internal layer 72 in ~~the~~ a printed mother board, a worksheet form, before being separated into ~~the~~ substrates 62. A pattern on the internal layer 72 of the substrate 62 is

connected to a land 73 connected to region ~~66~~ 69 for ~~the~~ a signal electrode with a through hole. The signal electrode 65 is separated along a cut line 63. The cut line 63 is spaced by ~~an absent~~ a distance 74 from the land 73. The ~~absent~~ distance 74 allows the substrates 62 in the worksheet form to be inspected prior to ~~the~~ separation. That is, ~~the~~ signal electrodes 65 of any two adjacent substrates 62 in the worksheet form are electrically isolated from each other, and thus, signals to them can be separated without a dummy substrate.

Fig. 14 is a perspective view of the substrates 62 in the worksheet form. ~~Since~~ Because of having five signal electrodes 65 on each cut side 63 thereof, ~~the~~ each substrate 62 forms a high-frequency module having various functions. The signal electrodes 65 are prevented from undesired burrs.

~~Since~~ Because of being provided on all ~~the~~ four lateral sides of ~~the~~ a substrate 62 of substantially a four-sided shape, the signal electrodes 65 are electrically isolated from each other despite small dimensions of the substrate 62. Therefore, the signal electrodes provide ~~the~~ a high-frequency module flexibly designed ~~flexibly in~~ with regard to patterns, and the module provides an apparatus with ~~an~~ a significantly-reduced overall size.

~~As described~~ In Embodiment ~~3~~ 4, the large-sized signal electrode 65a is in the recess 64 of the substrate 62 for grounding, which recess is formed ~~with~~ from a series of drilled round holes 53 to 57 (as shown in Fig. 10) which ~~as a second recess~~ extend~~ing~~ from the upper side to the lower side of the substrate 62. Thus, the electrode 65a can preferably be formed by a simple drilling process. ~~A~~ The shield case 66, upon being placed over the substrate 62 before soldering, has a leg ~~66~~ 66a to create a space between the leg and the signal electrode 65a. The space, upon being filled with soldering paste by a capillary action, allows the leg 66a to be soldered securely to the signal electrode 65a.

~~Since~~ Because of including the substrate 62 covered with the shield case 66

connected at ~~the~~ legs 66a to the signal electrode 65a for grounding, a ~~the~~ high-frequency module is handled easily, and receives and transmits little noise between it and an exterior thereof ~~the outside~~.

The signal electrode 65 of the substrate 62 and the leg 66a of the shield case 66 will be explained.

Fig. 15 is a plan view of a ~~the~~ high-frequency module including the substrate 62 and the shield case 66 soldered to the substrate 62. ~~The~~ Horizontal and vertical sides of the substrate 62 in the drawing are determined from ~~with~~ ~~the~~ cut lines ~~63~~. In this embodiment, the cut lines, i.e., sides 63 of the substrate 62 are spaced by a gap 81 of 0.07 mm to 0.15 mm from the leg 66a of the shield case 66. In other words, the cut side 63 projects by the gap 81 from ~~the~~ legs 66a of the shield case 66. This protects the shield case 66 from being injured by a cutter during ~~the~~ separation of ~~the~~ substrates 62 from a ~~the~~ printed mother board, i.e. a ~~the~~ worksheet form. If the gap is too small, ~~the~~ lateral sides of the shield case 66 may be injured during such ~~the~~ separation. Also, the ~~cut~~ sides 63, if ~~being~~ located further ~~more~~ outward, is increases an ~~the~~ overall size of the high-frequency module.

Since the shield case 66 is placed over a ~~the~~ printed mother board as a ~~the~~ worksheet form, a pattern of solder paste ~~82~~ is ~~are~~ transferred onto a ~~the~~ back, lower side of the mother board. After ~~the~~ soldering, ~~the~~ remaining spot 82a of the solder paste ~~82~~ are deposited on ~~the~~ land 70 of the substrate 62.

As described ~~in~~ above, the shield case 66 has the leg 66a soldered to the signal electrode 65. The ~~cut~~ sides 63 of the substrate 62, because of ~~since~~ extending further ~~more~~ outward than the leg 66a of the shield case 66, protect ~~the~~ solder between the leg 66a and the signal electrode 65 from external stress, thus preventing cracking of ~~providing no crack with~~ the solder.

A modification of ~~the~~ shield case 66 on ~~the~~ substrate 62 will be

explained. A ~~The~~ shield case 66, upon having an outer surface thereof roughened or textured ~~, has~~ exhibits an increase in ~~a~~ surface area ~~increase~~. This improves a property for heat radiation, and therefore, enables the shield case 66 to reduce an influence from heat developed from a ~~the~~ component on the substrate 62. The shield case 66 may have ~~the~~ lateral sides roughened with a dicing cutter during ~~the~~ separation of the substrate 62. This allows ~~the~~ ~~cut~~ side 63 of the substrate 62 not to project outwardly from a ~~the~~ lateral side of the shield case 66, thus contributing to ~~the~~ a reduction of a ~~the~~ size of the module. Also, a ~~the~~ dicing process can simultaneously entail ~~conduct~~ two different steps, ~~the~~ separation of ~~the~~ substrates 62 and ~~the~~ roughening of the shield case 66, hence eliminating an extra roughening step. ~~The~~ Roughening may be performed on ~~applied to~~ all the lateral sides of the shield case 66 or one particular lateral side. So ~~As~~ long as an ~~the~~ upper side is not roughened or textured, the module can remain not declined in ~~the~~ appearance.

The shield case 66 is manufactured from a metal sheet 86, such as a tin-plated steel sheet held on a die 85 and punched out into a shape with a punching die 87. This ~~The~~ punching may produce burrs on an ~~the~~ edge of the metal sheet 86, as shown in Fig. 16. The metal sheet 86 is then bent in a ~~the~~ direction of the punching to form a bend ~~bent~~ 66b as shown in Fig. 17. ~~The~~ Leg 66a is shaped on the bend ~~bent~~ 66b, and then the shield case 66 is completed. Since the shield case 66 is joined at a ~~the~~ signal electrode 65 to ~~the~~ substrate 62, ~~the~~ burr 88 produces a gap 91 between a ~~the~~ side wall 90 of ~~the~~ signal electrode 65 and the leg 66a. The gap 91 allows ~~the~~ soldering paste, molten by re-flow heat, to be distributed uniformly by a capillary effect. The burr 88, because of ~~since~~ not extending toward ~~s~~ ~~the~~ neighboring substrate 62, ensures a ~~the~~ distance from the neighboring substrate 62 and allows a ~~the~~ high-frequency module 60 to be protected ~~safe~~ on its lateral sides. In Fig. 17, a resistor 92, i.e. a ~~the~~ heat generating component, is mounted on the substrate 62.

Then, the shield case 66 has ~~the~~ its upper side provided with a mark that is impressed thereon. The mark, upon being made at once on an array of ~~the~~ shield cases 66 in ~~the~~ a worksheet form, is produced efficiently. The mark, upon being made with laser beam, is ~~performed~~ provided at a uniform position regardless of ~~the~~ a type of ~~the~~ module~~s~~, to be produced and thus ~~offering a~~ quality ~~of~~ appearance is provided. The mark is made ~~out~~ with a laser beam easily at high~~er~~ speed. Moreover, the mark made by a laser beam can remain intact when being touched by a finger.

As set forth above, the substrate 62 of this embodiment is extended at the ~~cut~~ sides 63 outwardly from the shield case 66. This allows ~~the~~ a soldered region of the shield case 66 not to accept directly any external stress, and ~~or~~ not to crack ~~produce cracks~~. The shield case 66 is protected from being injured by a cutter for separating ~~the~~ substrates 62 from ~~the~~ a printed mother board of ~~the~~ a worksheet form.

Alternatively, ~~the~~ a cut side of ~~the~~ substrate 62, upon being substantially identical to ~~the~~ ~~cut strip~~ side 63, allows ~~the~~ a high-frequency module to have a reduced overall size. This reduces a redundant portion of a pattern of a printed circuit on ~~the~~ a printed mother board to ~~has~~ have a redundant portion.

The shield case 66, upon being roughened on its lateral side more than its upper side, ~~has its~~ exhibits an increase in surface area, ~~increasing~~ thus ~~having an~~ exhibiting improved heat radiation. ~~The~~ Roughening of its lateral side, increasing ~~the~~ friction, allows ~~the~~ a high-frequency module to be held easily during ~~the~~ a manufacturing process.

~~Abstract~~ ABSTRACT OF THE DISCLOSURE

A high-frequency module has a signal electrode provided on a cut side thereof, and is arranged to produce no burrs. The module includes a substantially four-sided substrate, a recess at ~~the~~ a cut side of the substrate, and a signal electrode at the recess. The signal electrode is spaced ~~isolated~~ from the cut side by ~~an absent~~ a distance.

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FIG. 8

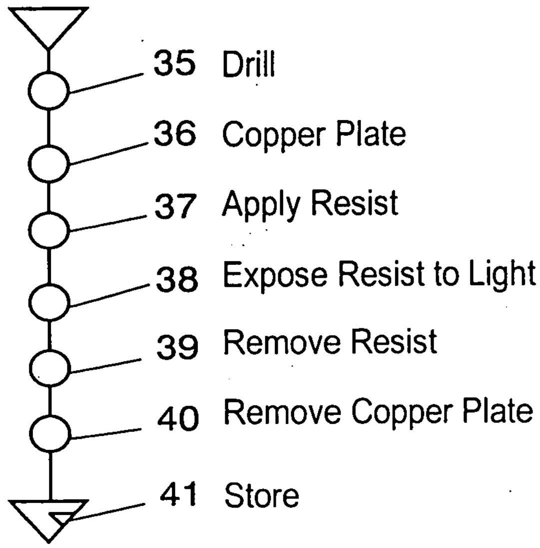

FIG. 9

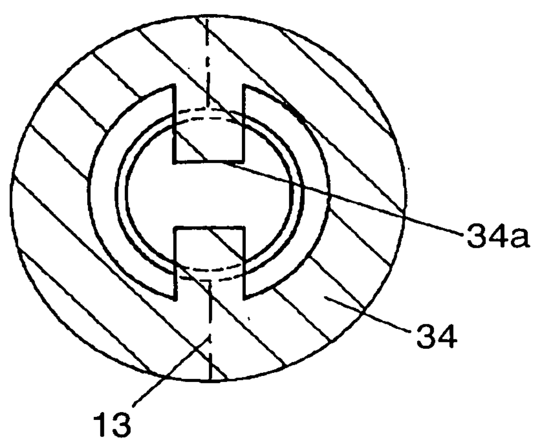

FIG. 10

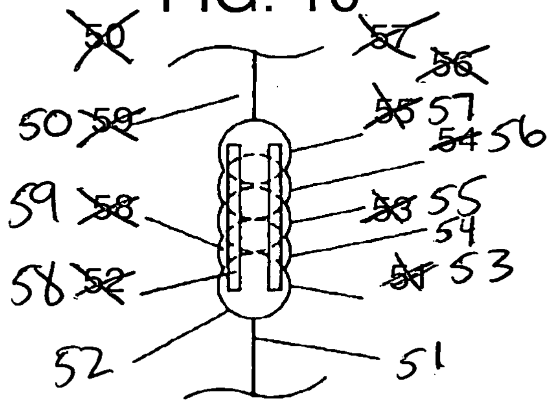

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FIG. 11

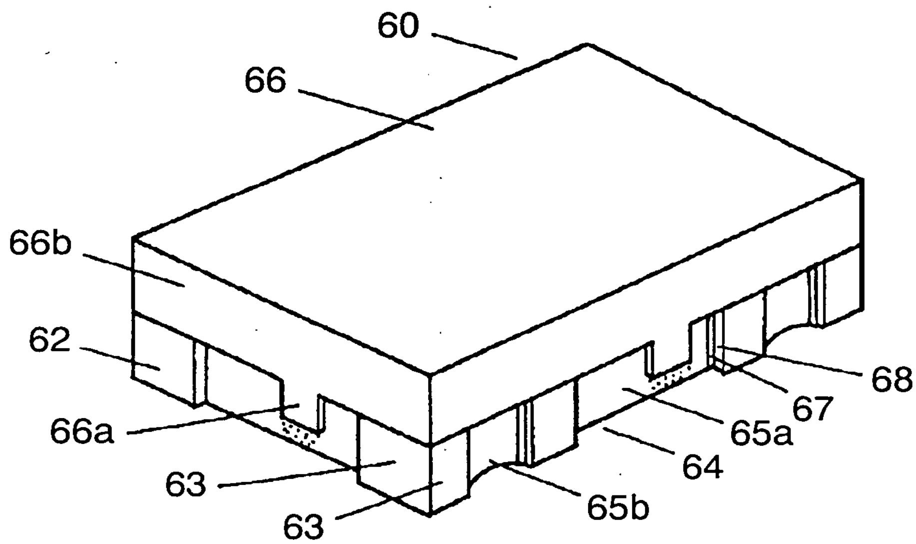

FIG. 12